CHAPTER 4: BIODIVERSITY / WILDLIFE HABITAT ASSESSMENT

Introduction

The first assessment to be developed was the Biodiversity and Wildlife Habitat Assessment. The process and results of the Biodiversity and Wildlife Habitat Assessment were initially developed by an assessment team made up of N.C. Natural Heritage Program staff, and then reviewed by field ecologists, biologists and botanists from several state environmental agencies. The results were also compared to other inventories and studies of important natural resources in North Carolina. Most areas identified by the assessment were largely consistent with existing focus areas of state and local conservation organizations.

The first step in developing a conservation map is to consider the scope of ecosystem functions to be included. Ecosystem functions conceptually include the whole spectrum of what ecosystems do: supporting the hydrologic cycle, cycling nutrients, fixing carbon, producing oxygen, supporting a large number of plant, animal, fungal and other species, evolution and adaptation of species, pollination and gene dispersal, generating soils, stabilizing slopes and numerous others.

To focus conservation priorities from the overwhelming complexity of possible functions, several principles prove to be useful:

- Many of these functions are inherent in any healthy natural ecosystem, and therefore do not require targeting specific places for conservation.
- Many functions cannot be directly measured.
- Other functions we know are tied to particular kinds of places, and these do need a special focus.

Certain places that support highly specific functions at high levels of integrity also support a broad range of other functions that we are not able to measure directly. Previously defined places, such as Significant Natural Heritage Areas (SNHAs) or Outstanding Resource Waters (ORW), or other intact large scale landscapes represent the most important places to focus conservation action, because they indicate high quality systems.

Methodology

The critical components that were selected to rank natural areas for the Biodiversity and Wildlife Habitat Assessment were determined through a rigorous evaluation process. Areas in the landscape were evaluated for their rarity and distinctiveness, their function and then the accuracy, precision and completeness of the appropriate data sets that were selected to represent them.

The main focus areas for the Biodiversity and Wildlife Habitat Assessment were aquatic and terrestrial habitat, landscape function and connectivity. Other vital

processes were included in the overall evaluation to address the roles that wetlands, floodplains and stream buffers play in the ecosystem. The assessment team chose to identify mappable indicators of the most site-specific ecological functions. Multiple data sets were selected initially. These were further examined for redundancy, accuracy, precision, completeness and relevance to our conservation mapping goals. Many data layers were eliminated at this stage, producing a smaller set of final data layers to be used. The data layers selected are the best representations of ecological functions targeted in this process for conservation.

For assessment of biodiversity, the available data represents three major components of ecological resources. These are:

- Biodiversity, both of aquatic and terrestrial species and communities;
- Large scale terrestrial landscapes, including core wildlife habitats and habitat connectors; and
- Other lands of particular importance to ecosystem processes, such as riparian buffers and wetlands.

Rare species and targeted natural habitats are indicators of landscapes that are currently functional. To ensure that our native species of plants and wildlife flourish, the significant natural areas that support them must be identified and preserved.

The Conservation Planning Tool focuses on the identification of existing significant habitats, based on the needs of both wildlife and humans, as well as focusing on lands that can be identified as serving multiple benefits for compatible land uses. The majority of the state's Wildlife Action Plan priority species and their associated habitats as identified by the N.C. Wildlife Resources Commission are included. Lands that can contribute to this system of essential natural habitats include rivers, wetlands, floodplains and coastal waters, working farms, forests, parks, game lands and urban forests.

Terrestrial Measures: Conservation of biodiversity, as an indicator of a healthy ecosystem, requires the conservation of a very large number of species, most of which have specific habitats and therefore require site-specific conservation. Some species are common and general enough in their needs that they don't need special attention. The biodiversity focus therefore was aimed mainly at species that are rare or are sensitive for other reasons. Ecosystem integrity is represented by selecting high quality examples of natural communities that serve as coarse filters for less-known species that are not measured directly. For terrestrial natural communities, the Natural Heritage Program database of community occurrences was used, and the set of Strategic Natural Heritage Areas (SNHAs) that represent the best available information about the best examples of each of these community types.

Wildlife habitats were identified as large scale terrestrial landscapes that support processes that act over long distances, and included species that require large areas. This includes wide-ranging species such as large carnivores, edge-structure sensitive forest interior species, and species that depend on metapopulation structure. These ecosystem functions generally have less need of high local integrity, and more need for contiguous large patches of habitat and the existence of connectors between them. While large-scale landscapes are often evaluated in a very general way, as if all landscapes were alike, the species and processes that large-scale landscapes support is specific to the kinds of habitat they contain. Maps of landscape habitat indicator guilds were used as our primary assessment of larger-scale landscape function, as well as Important Bird Areas (IBAs) as defined by the Audubon Society. Landscape Habitat Indicator Guilds is a process developed by the NHP staff to evaluate landscape integrity and function and is explained in detail in Appendix D.

Other significant lands include riparian buffers and wetlands. Wetlands support several important processes of hydrologic regulation and nutrient cycling. In the Coastal Plain, the Division of Coastal Management has rated wetlands for their level of function. This data set of N.C. Coastal Region Evaluation of Wetland Systems (NC CREWS, 2003) was used where available. In the rest of the state, the National Wetlands Inventory (NWI) was used. The NWI contains little indication of wetland integrity, but was the only mapped data on wetlands available outside the coastal region.

Aquatic Measures: For aquatic natural communities, no similar database exists like the one for terrestrial communities. Several other data layers were used as surrogates: streams with Division of Water Quality's Excellent or Good Bioclassification ratings, Outstanding Resource Waters (ORW) and High Quality Waters (HQW), natural swamp waters, native trout streams and anadromous fish spawning waters. These data sets, represented by GIS data layers, distinguished areas of high integrity but did not allow addressing individual aquatic community types beyond a very coarse level. Rare plant and animal species are tracked directly by the Natural Heritage Program. Occurrences of the best examples of each are incorporated into the SNHAs, while examples with lower integrity are represented by element occurrence (EOs) records not in SNHAs.

Basis for Ranking

North Carolina's future depends on the adequate sustainability and protection of the full spectrum of ecosystem functions, which will require different methods of conservation over a wide range of sites and over large areas. Within the areas identified as important for ecosystem function, the relative ranking is intended to provide a focus on the areas that warrant the most urgent, most intensive or strongest efforts at protection. These are the areas for which the data are most

specific and reliable, and these areas are the most distinctive (least readily replaceable by other areas).

The ranking scale is a categorical ordinal scale. The rankings show relative significance of the areas but are not quantitative. Neither comparison of proportions nor addition of ranking categories is appropriate. The use of an ordinal scale is appropriate for a variety of reasons, including the incommensurate nature of the data and factors used, the difficulty in translating objective measures into quantitative measures of actual ecological value, the way in which quantitative methods can easily obscure the true nature of decisions, and the lack of quantitative data for many of the measures.

The relative ranking of each unit of land, or 30 by 30 meter cell, was derived from rankings of the individual data layers representing different functions. Each data set was given a ranking between 1 and 10. Ten categories were condensed into seven distinct relative values and given a verbal description for ease in understanding the relative conservation value assigned (Appendix B).

Data layer rankings assigned, using professional judgment, were based on a combination of qualities of the ecological values represented and the following factors:

- Resource rarity and distinctiveness
- Resource function
- Data precision, accuracy and completeness

The assessment team used these three factors as guiding principles to select and rank data sets. The method used for determining the relationship of the data to the guiding principles was professional judgment and peer review of the assigned rank.

Rarity and distinctiveness of the feature mapped are important for determining how much focus is warranted on specific locations on the map. While every place is to some degree unique, places that support the rarest resources represent the greatest loss if they are destroyed. Among sites of more common resources, those with the highest quality or integrity are rare and most irreplaceable. If lost, only inferior examples remain to be conserved in their stead.

For conserving and sustaining diverse sets of resources, such as species or community types that are scattered across the landscape, the most careful conservation biology treatments have utilized methods for identifying portfolios of sites to represent all of the biodiversity elements of conservation concern (hereafter referred to as elements). While there are different ways of doing this analysis, portfolios that select multiple examples of each element and contain the best examples of each element offer the best chance of conserving diversity. Besides quality of occurrences, portfolio analysis includes a goal for how many

examples of each element should be included. These goals may be equal, may be based on range beyond the analysis area, and may include regional stratification or other factors. Such an approach was used by The Nature Conservancy in its ecoregional planning process (Designing a Geography of Hope (Groves et al. 2002) and was used by Florida in its statewide land conservation analysis (Florida Natural Areas Inventory, 2006)). The portfolio selection process ensures a balanced focus, and prevents either the more common elements or the rarest elements from commanding the sole focus. Examples of elements that were not included in the portfolio still have value, but are known to be represented by a reasonable number of better examples, and are best given lower priority than those in the portfolio.

Some data used in this assessment, such as SNHAs, incorporate such representative portfolio analysis. It is hoped that similar analysis to identify a balanced portfolio of the best examples can be used in other data sets in the future, as this approach allows the sharpest focus on the most important sites. Where such analysis has not been done, rarity and range of diversity was used to determine how much focus to give to specific data layers. Data layers that included only very high quality examples contained few locations (such as ORWs), and were ranked higher than data layers that included numerous areas or mapped resources or levels of integrity that appeared to be more common (such as good IBI ratings). Where data layers contain both rare and common elements that are not distinguished, such as the different aquatic community types represented by the stream bioclassification ratings, they were ranked lower than if rarer elements were able to be distinguished.

For the conservation of the state's native biodiversity, protection of well-functioning ecosystems that are still essentially intact (possessing a high degree of "integrity") is one of the goals, not just the protection of rarest species. By protecting high quality ecosystems, this assessment aims to conserve the majority of the state's species (not just the rarest ones), ecologically or taxonomically distinct populations, natural communities (of animals as well as plants), and the ecological processes that are responsible for both creating and maintaining the features of these ecosystems. Protecting as many examples of intact ecosystems as we can is also a goal since in natural systems redundancy is a primary factor ensuring stability and, hence, viability.

While a focus on rare species and communities is of value in a triage system of conservation -- targeting the most vulnerable elements of the state's biodiversity for the most immediate attention -- one of the aims of conservation should be to be as comprehensive in its coverage as possible. In this sense, making sure that all high integrity ecosystems receive some consideration -- whether or not they contain any rare species or communities -- is also of value. Most conservation agencies, in fact, use measures of ecosystem integrity as their primary means of setting their priorities, giving equal weight to virtually all ecosystems meeting a certain level of integrity.

Examples include:

- Division of Water Quality's nomination as ORW or HQW protection for any stream segment having an Excellent water quality rating based on its Bioclasses (in which the rarity of species plays no explicit role);
- Ecosystem Enhancement Program's targeting of preservation credits in any watershed where ecosystems meet certain minimum criteria for integrity;
- Division of Coastal Management's targeting of all high quality shellfish areas, fish nursery areas, submerged aquatic vegetation, etc.;
- Wildlife Resource Commission's targeting of all native trout waters.

The Natural Heritage Program's targeting of high quality plant communities -- including common varieties -- for conservation also serves this goal: the presence of intact vegetation is one indication that the ecosystem possesses a high degree of integrity, and therefore is said to have more probability for high function. However, the quality of the plant community is not a sufficient measure of ecosystem integrity by itself - an area can have essentially intact vegetation but still be missing many of its most characteristic species of animals. Other measures are also needed, including the measure of landscape integrity that are being addressed through use of the Landscape/Habitat Indicator (LHI) Guilds analysis.

By combining an attention to rarity/vulnerability with attention to comprehensiveness -- by giving weight to measures of ecosystem integrity and function in addition to triage factors -- this assessment will come closer to effectively reaching the objective of biodiversity conservation than through following either of the two approaches by themselves.

Accuracy of the mapped feature refers to both the spatial accuracy and the content accuracy of the data - does it represent the value its ranking suggests? Data layers that are lower in precision or had low spatial resolution are deemed less suitable for focused conservation action, and so were given lower ranking. Data layers that have too low resolution or are of questionable accuracy were not used. Confidence in the content of data layers is conceptually distinct from spatial precision and accuracy, but they have a similar effect on ability to focus on particular areas. Level of knowledge has a major effect on content accuracy. Data layers that are based on site-specific survey generally represent more knowledge than those derived from remote sensing or model-based programs. Survey or remote sensing techniques that directly measure the factor(s) of interest represent a higher level of knowledge. Since this assessment uses the data layers to represent ecosystem functions, the more directly the data layer measures the ecological functions of interest, the higher the level of knowledge. Low accuracy is a reason to avoid using particular data layers, and those that were limited in these qualities were ranked lower.

Completeness is important because the assessment ranks places in comparison with other places. If only a small fraction of existing comparable places are represented, there is little confidence that the areas represented are more important than any other areas. Data layers that were not reasonably comprehensive were not used. However, completeness was necessarily balanced against the importance of a data layer in representing factors no other data layer could represent. An exception to the completeness principle was the Landscape/Habitat Indicator Guilds. This information was vital to understanding the connectivity and habitat needs in the coastal region, where it is well underway. At this point, the Guilds are complete in the coastal regional for only riparian species and habitats (see page 11). Completion of the remainder of the state for riparian areas is underway, with upland species and habitats to follow.

Maximum Ranking Approach

The ranking system follows the outline of a decision model or suitability model. The spectrum of ecological factors to be covered was determined by the scope of the project. The model focuses on factors that are site-specific. Mappable measures of these factors were identified, and GIS data layers identified to represent them. The factors covered in the project, how they were grouped, and the data layers used to represent them, are shown in the appendices and described in detail in Chapter 5.

Some ecological processes, such as purification of air, soil formation, evapotranspiration and nutrient cycling, occur in a diffuse pattern wherever there is natural vegetation. These functions are included implicitly, and will be covered by places identified for the other purposes.

Each individual data layer was given a ranking or rankings between 1 and 10, or “moderate conservation priority” to “maximum conservation priority.” Where the data layer was quantitative or scaled, this inherent scale was used to derive multiple rankings. Many of the data layers represented only presence-absence (binary) values, which was assigned a single value on the 1 to 10 scale (e. g. presence of native trout waters or shellfish harvest waters). A few had non-scaled categorical attributes that were assigned different values on the 1 to 10 scale (e.g. significant natural heritage areas, which were ranked 7-10 depending on their significance level). The 1 to 10 scale represented the final scale. Rankings for each data layer could consider the rankings of other data layers for comparison. These 10 rankings were then consolidated into seven categories of significance, ranging from “moderate” to “maximum” conservation priority.

Grid cells (30 x 30 meter pixels) on the map that support more than one category of data were assigned the maximum value of the individual rankings of the data layers. In other words, a cell may receive a value for multiple data factors found to exist in that location, but only the highest score is shown. Using the maximum

value offers several advantages. It is appropriate for an ordinal scale. It allows the importance of the most important areas to come through, without being diluted by absence of other factors. It is simple and transparent, and facilitates analysis and discussion about the meanings of the rankings. Rankings of each individual data layer can be thought of directly in terms of the final ranking scale, and compared directly between scales. In addition, it is less sensitive than other combination techniques to redundancy in input data or the risk of double-counting. There is also value in knowing the range of resources that may be underlying the maximum score. All of the scores can be seen through the development of a value attribute table (VAT) that shows all data found in that cell. This provides additional information and may indicate additional collaboration opportunities and potential multiple funding sources that focus on particular types of resources.

The primary disadvantage of using the maximum is that it does not give greater credit to areas with multiple values present. At each step of the evaluation process, the assessment team asked whether the presence of additional factors should raise the value of a cell beyond that of the maximum single factor. The conclusion was that it should not, and that taking the maximum was appropriate.

Data Sources and Ranking
Details of inclusion and ranking for each selected data layer

Terrestrial Habitats:

- Significant Natural Heritage Areas (SNHA) – Nationally and State Ranked

  Significant Natural Heritage Areas are delineated by the Natural Heritage Program. They contain known locations of rare species or rare or high quality occurrences of natural communities. Their boundaries represent the areas containing the significant rare species and natural communities within them, as well as the habitat that is necessary to maintain the rare species and the quality of the natural community. In addition to the conservation target of each SNHA, numerous other species occur, and most ecosystem functions are well supported.

  SNHAs are designated as national, regional, state or county significant using parameters developed by the NC NHP, NatureServe and The Nature Conservancy to measure statewide and global rarity for rare species and communities. The criteria used for site significance are:

  National Significance: Sites containing examples of natural communities, rare plant or animal populations, or other significant ecological features that are among the highest quality occurrences of their type in the nation. Comparable (or more significant) sites may occur elsewhere in the nation.

State Significance: Sites considered containing examples of natural communities, rare plant or animal populations, or other significant ecological features that are among the highest quality occurrences in North Carolina after nationally significant examples. There may be comparable (or more significant) sites elsewhere in the nation or the state.

Regional Significance: These sites contain communities or species that are represented elsewhere in the state by better quality examples, but which are among the highest quality or best examples in their geographic region of the state. The geographic region within which they are considered is based on location and geologic and/or geomorphic similarity. Regions consist of areas that are relatively similar in their geology, soils and other ecologically important factors. They are about the size of five counties, but do not necessarily follow county lines.

County Significance: These sites contain communities or species that are represented elsewhere in the region by better quality examples, but which are among the highest quality or best examples in their county.

SNHAs represent the most important finer scale sites for biodiversity in North Carolina – the best sites for the rarest species and the best examples of all natural community types as defined in the Classification of the Natural Communities of North Carolina (Third Approximation) (Schafale and Weakley 1990). Protecting examples of natural community types should protect many other species and ecosystem functions as well. Each site represents a component of a representative portfolio and is not interchangeable with any other. The different levels of significance represent portfolios of different geographic scope.

In addition to their relative significance, SNHAs are relatively precise and well-studied. Each SNHA is individually drawn by a trained ecologist after studying the area on the ground and documenting the rare species and natural communities they contain. Protection of the full suite of SNHAs is needed to conserve the diversity of rare species and their habitats within the state. Loss of any one entails the loss of one of the few best examples of at least one rare species or NHP natural community type, leaving North Carolina with only more degraded or less viable examples. In many cases, no other examples would be available to replace lost SNHAs.

SNHAs received a ranking of Highest Conservation Value (10), High Conservation Value (9) or Medium-High Conservation Value (7), depending on their NHP-assigned significance. National and state significant SNHAs are both given the highest ranking since protection of the full set is required to meet the goal of minimally protecting all of North Carolina's natural diversity. Regionally significant SNHAs are given only a slightly lower ranking because

they are necessary for robust protection of the state's biodiversity and for minimal protection of the biodiversity of the different regions of the state.

County significant SNHAs are important to conserving biodiversity at the county level and provide stronger protection for the state's biodiversity in general, but the data set representing them is less complete. They also often represent somewhat less thorough survey and delineation. For these reasons, they are ranked two steps below the regionally significant SNHAs.

- Free-Standing Element Occurrences
  Element occurrences (EO) are areas of land or water where elements of biodiversity - rare species or significant natural communities - occur. Rare species and natural communities are important and sensitive components of biodiversity. The most important occurrences are incorporated into SNHAs. However, other "free-standing" occurrences have additional value for viability of the elements in North Carolina. Occurrences have NHP rankings indicating their quality and viability (EO ranks), their precision (representation accuracy), and their currency (EO ranks and last observed date) (NatureServe 2002), which were used in selecting and ranking them for this plan. The elements (species and communities) they represent have NHP rankings indicating their global and state rarity (G ranks and S ranks) (Franklin 2006, LeGrand et al. 2006). Only occurrences that are believed viable and are reasonably spatially precise and accurate are used. Occurrences with excellent or good viability (A and B ranked), and occurrences considered critically imperiled or imperiled at the global or state level (G1, G2, S1 and S2) received an assessment ranking of medium to Medium Conservation Value (6). In cases where two or more viable occurrences occurred within the same cell, that cell received a ranking of medium to Medium Conservation Value (6). All other lower-ranked viable, current and spatially precise occurrences received a ranking of Medium-Low Conservation Value (5). These included elements considered vulnerable (but not imperiled) at a global or state scale (NHP ranked G3 or S3 respectively) and occurrences with fair (but not excellent or good) estimated viability or integrity (with EO rank of C).

- Important Bird Areas (IBA)
  IBAs, as defined by Audubon, represent sites important to the long-term viability and conservation of naturally occurring bird populations in North Carolina. IBAs represent a collection of sites that are assembled by a process of nomination and approval. Many of the areas appear to be of high spatial precision; however, some have inclusions of seemingly degraded habitat.

  Some IBAs are selected as the best examples for particular species or assemblages, and others are sites that are important but may be less unique. Because they represent important areas but may not be the best examples, represent an incomplete set of habitats, and may contain inclusions of poorer habitat, they are ranked fairly lower than SNHAs or the more precisely

mapped aquatic systems. Cells with IBA currently receive a ranking of (6). Additional prioritization within IBAs is underway by Audubon, which will most likely result in an adjustment in the current ranking in future iterations of the assessment.

- Landscape / Habitat Indicator Guilds
  The North Carolina Natural Heritage Program (NHP) uses a survey-based approach to identify and evaluate ecologically significant landscape units across the state. As in NHP's standard approach to mapping and evaluating occurrences (EOs) of rare species and natural communities, we identify and rank occurrences of landscape units according to the biological features they contain, as recorded in ground-based surveys. While we also use aerial photographs, GAP vegetation cover maps, and other data obtained from remote sensing to map the overall extent of a given habitat unit, all units must contain a minimum number of survey records to qualify for inclusion in our system. Units are also ranked according to their surveyed contents rather than by size, shape, patchiness, or other measures of a habitat block derivable from remote sensing.

  Landscape/Habitat Indicator (LHI) Guilds are groups of species whose presence is indicative of landscape integrity, i.e., where either large blocks of habitat persist or where a number of smaller blocks are sufficiently well-connected to support breeding populations of these species. These guilds are identified for a particular type of habitat, with both the habitat and the list of indicator species defined at the same time for a given guild (Hall, S. 2006). The guilds, much like the SNHAs, are good indicators of functional ecosystems. Guild indicator species are habitat specialists, but the habitats they occupy typically represent a combination of different natural communities. For example, the Wet Hardwoods guild in the Coastal Plain includes species that are primarily restricted to floodplain forests, but include the following five types of natural communities within their habitat range: Blackwater Bottomland Hardwoods, Brownwater Bottomland Hardwoods, Brownwater Levee Forest, Coastal Plain Small Stream Swamp, Nonriverine Wet Hardwood Forest. The indicator species represent a wide range of species, including rare species but also a wide variety of more common species, many of which are target species for the Wildlife Resource Commission's Wildlife Action Plan.

  Since this includes most species and most ecosystems, conservation of large, intact blocks of habitat is critical for the preservation of the states' biodiversity and can play a particularly important role in plans to protect the state's ecological infrastructure. Identification of intact (or as intact as now exist) landscape units is complementary to NHP identification and prioritization of high quality SNHAs.

Occurrences of rare species and natural communities that occur in large intact landscapes, as indicated by LHI guilds, are more likely to be included in SNHAs, and SNHAs embedded in them are more likely to be ranked as highly significant. However, LHI guilds, core areas and connectors are not tied specifically to rare species. They are defined based on species selected to represent landscape-scale ecological functions, and are selected from a broader range of species. The habitats eligible for inclusion within LHI Core areas or connectors represent a wider array of types than those described in the Third Approximation (Schafale and Weakley 1990), including successional habitats and some examples of sylvicultural or agricultural lands. LHI core areas can thus be defined even in the absence of other NHP elements or SNHAs and, consequently, cover a larger portion of the state and serve a wider range of species and ecosystems.

The Elements of our landscape analysis – analogous to NHP Species or Community Elements – are termed Landscape/Habitat Indicator Guilds. We term the overall process of identifying and ranking these units LHI Guild Analysis, and, as implied by the name, there are several features that characterize this approach:

Landscape Units: Mapped occurrences of the LHI guilds are termed *core areas*. These units are intended to represent habitat units that are still large enough and/or well-connected enough to support the entire range of species associated with a particular landscape type (defined by habitats – see below). Core areas are defined as consisting of residential habitat for these species, including foraging, denning and breeding habitats. Core areas are also theoretically traversable from one end to the other. Although there may be gaps in suitable habitat embedded within the core areas, all are assumed to be crossable. Core areas therefore have a connecting function as well as a residential function. The boundaries of a core area occur at the edge of wider habitat gaps that are unlikely to be crossed, including impassable barriers such as four-lane highways. In some cases, we define Between-Core Connectors that bridge these larger breaks between two identified core areas. However, these features are regarded as much more speculative – not based on survey data – than are the core areas, and are consequently only a secondary focus of our landscape analysis.

Habitat-by-Habitat Analysis: LHI guilds, as implied above, are defined according to the habitats they use for residence, foraging, and breeding. Within a given geographically defined area, species may “see” the landscapes they occupy very differently, depending on their habitat associations. Black bears, red-cockaded woodpeckers, and Venus flytrap moths may all live side-by-side within a particular longleaf pine savanna, but differ greatly in their use of other adjoining types of habitat, such as sandhills, pocosins, or pine plantations. Depending on the extent and

distribution of these habitats, these species may “see” the landscape as being more-or-less continuous or highly fragmented. Consequently, landscape integrity – or its obverse, habitat fragmentation – must take habitat associations into account. Hence our use of combined *landscape/habitat units* as the basis for our analysis.

Indicator Species: The heart of our survey-based approach is the use of indicator species to determine what habitat units constitute core areas and what priority rank they should receive. These species are selected based on their sensitivity to the integrity/fragmentation of specific types of habitat. They are thus selected on a functional basis rather than on rarity, the main criteria used to define our other types of NHP Elements. They must be both habitat specialists – the species most likely to be affected by fragmentation, loss, or degradation of a particular type of habitat – and dependent on the presence of large areas or inter-connected blocks of habitat.

Habitat specialist animals fit these requirements better than plants, since they typically have much larger individual spatial requirements, having to move around to acquire food, water, shelter and mates. Many animals have larger spatial requirements at the population level, as well, particularly species that cope with environmental disturbances – e.g., many species of insects – by living in meta-populations, with subpopulations dispersed over many separate habitat units.

Grouping by Guilds: Indicator species are treated as groups rather than individually. These groups are termed guilds since they are defined on the basis of common ecological factors – in this case affinity for particular types of habitat – rather than taxonomy. As is true for other ecological guilds, they also have a particular structure: the membership of each guild is mutually exclusive – a species is assigned to just one guild – but different guilds can overlap spatially. These structural features strongly distinguish “guilds” from “communities,” which have broadly overlapping membership but little, if any, spatial overlap.

LHI Guild Analysis proceeds by compiling survey records for a particular guild and looking for concentrations of records within a given unit of habitat. Core areas are defined wherever at least 25% of the guild members have been recorded. The quality of the core area – its *Occurrence Rank* – is based on the proportion of guild members recorded within it, estimating how well it has maintained the complement of landscape/habitat sensitive species expected to occur within that area. C-Ranked occurrences have between 25-50% of the expected species, B-Ranked between 50 and 75% and A-Ranked between 75 and 100%.

Analogous to other NHP Elements, each LHI Guild is given an *Element Rank* based on the number, size, and frequency of core areas that exist within the state (only State Ranks are currently definable), the quality of the core areas, and their degree of threat. Since core areas for different guilds can overlap spatially, composite *Landscape Ranks* can be calculated for given areas as a weighted sum based on the number of guilds that are present, their Element Ranks, and their Occurrence Ranks. The North Carolina Conservation Planning Tool calculates these values on a pixel-by-pixel basis across the entire state.

For more information on LHI Guilds, see Appendix D.

- Wetlands
  Wetlands are areas of land where hydric conditions are a dominant environmental factor. The standard definition of wetlands that fall under federal jurisdiction as waters of the United States requires that soils be saturated with water for at least two weeks during the growing season, that soils show characteristics created by saturation, and that vegetation be composed predominantly of hydrophytes (plants adapted to growing in water or on a substrate that is deficient in oxygen due to excessive water content) (USACE 1987). Wetlands play particularly important roles in hydrologic cycling, water quality and nutrient cycling, as well as serving as important kinds of habitat and distinctive sites for many other ecosystem functions.

  Wetlands across North Carolina were mapped by the National Wetland Inventory (NWI, 1983) of U.S. Fish and Wildlife Service. In North Carolina's outer Coastal Plain, wetlands maps were refined by the N.C. Division of Coastal Management, and were rated for function by a multi-factor rating model called the Coastal Region Evaluation of Wetland Systems. Ratings were high, medium and low function (NCCREWS, 2003). As a general class individual wetlands are not highly unique. Rare types and particularly high quality occurrences are covered by SNHAs and community EOs, so this data layer represents the remaining wetlands. However, in the parts of the state where wetlands are represented by NWI (in the Piedmont and Mountains), wetlands are rare and very important. NWI mapping represents only a moderate level of accuracy, and does not have a scale to determine condition or integrity. These areas are therefore given a fairly low ranking but not the lowest. NC CREWS data represents a higher level of accuracy, and has an internal rating that allows differentiation among different levels of condition or function. The most functional wetlands with the highest level of accuracy are therefore ranked higher, and the least functional and least accurate are ranked lower.

Aquatic Habitats

- Aquatic Significant Heritage Natural Areas (ASNHA) – Nationally and State Ranked
  ASNHAs are conceptually similar to terrestrial SNHAs. They represent the waters that are of most importance to North Carolina's biodiversity. They are defined based on the actual presence of rare species. Unlike terrestrial SNHAs, community types are not used. There is not yet any classification or inventory of aquatic community types. For this reason, several other data layers were used (see below) to represent the most important aquatic communities. Because the protection of waters depends so strongly on the land adjacent to them, the area included for ASNHAs includes not only the water itself, but a buffer of 300 feet on each side of the streams and other water bodies. Buffers on streams within the watersheds of ASNHAs with federally listed species are given 200-foot stream buffers (per WRC 2002), and all other buffers on streams contributing to ASNHA watersheds are 100 feet; these stream buffers are given higher ratings because of the presence of rare species. Buffers are defined as a measurement from the toe of the slope on one side of the water body.

  Because ASNHAs are the most important areas for North Carolina's aquatic biodiversity, some of them received a top ranking. Nationally significant ASNHAs represent the best in the nation, but not all of North Carolina's biodiversity is represented by them at even a minimal level. Since this assessment is intended to cover all of North Carolina's ecological needs, the best examples in the state also merit attention at the highest level. This is a small set, even within the ASNHAs. Regionally significant SNHAs are more numerous, but are still rare, limited in extent and among the best of their kind. They offer distribution of the elements throughout their ranges within the state, an important consideration for their long-term conservation.

- Native Trout Waters
  These are waters that contain the naturally occurring and reproducing strains of Northern and Southern Appalachian Brook Trout. The stream reach where the native trout are known to occur, along with its 100-foot land buffer, is included in the model. Mapping and management of data related to Native Trout Waters is conducted by the Wildlife Resources Commission.

  The Southern Appalachian Brook Trout is the only native trout species in North Carolina, and they serve as indicators of the health of the watersheds they inhabit. Robust wild brook trout populations demonstrate that a stream or river ecosystem is healthy and that water quality is excellent. They indicate good examples of a particular kind of aquatic community.

  These waters represent a portion of the most significant aquatic communities in the state. They are rare and considered among the best, but do not

represent a portfolio or selection of the best examples. They are based on well-studied sample points that represent a high level of site-specific knowledge of community condition, and therefore receive a (9) ranking.

- Anadromous Fish Spawning Areas
  Anadromous fish spawning areas consist of portions of freshwater streams and rivers and the adjacent flooded wetlands that are used by anadromous fish for spawning of eggs. Anadromous fish include species that must migrate from the ocean upstream to freshwaters to spawn. Some species, such as striped bass and blueback herring, require strong current velocities and spawn in the mainstems, while others, such as alewife and shad, prefer slower currents and spawn in small streams and flooded wetlands. Because of the important contribution of riparian areas to the life cycles of these fish species, 100-foot buffers are included in the mapped anadromous fish spawning areas.

  Anadromous fish spawning areas provide a critical function for several different anadromous fish species. Many of these species are important commercial or recreational fishery species (striped bass), some are depleted due to habitat alterations and fishing pressure (alewife and blueback herring) or are state and federally listed (shortnose sturgeon – state/federally endangered; Atlantic sturgeon – state and federally listed as species of concern). These species cannot survive if suitable spawning area is not maintained. For spawning to be successful and eggs to survive, high water quality conditions are needed in these areas (adequate oxygen levels, low sedimentation, and natural flows). Protecting these areas would strategically conserve not only a complex of important fish species, but would help maintain downstream areas for juvenile anadromous fish and other species.

  Anadromous fish spawning areas are given a value (8) rank because they generally represent high quality habitat that is essential for multiple species, including rare species, and have fairly good data to support delineation. The Division of Marine Fisheries has noted that protection of all anadromous fish spawning areas is a high priority. Anadromous fish use areas were designated by the N.C. Marine Fisheries Commission and Wildlife Resources Commission based on extensive coast-wide sampling for presence of eggs, larvae and ripe females. However supporting data is sparse in some areas, and somewhat outdated. Updated data on current spawning activity or results from DMF's Strategic Habitat Areas (SHA) analysis should be used to sub-select the areas of highest priority in the near future.

  As with other data layers used to represent aquatic communities, Anadramous Fish Spawning Waters show high community quality and are relatively uncommon, but do not represent a selection of the best examples. For this reason, they do not receive a maximum value ranking.

- Fish and Benthic Bioclassification – Excellent/Natural and Good
  The bioclassification of N.C. streams uses a multimetric index that rates the quality of warm water streams. The presence, condition and numbers of the types of fish and benthic macroinvertebrates provide accurate information about the health of a specific water body. Bioclassification ratings are assigned by the Division of Water Quality following a standardized protocol. For this project, the stream reach in which the sampling point occurs, along with its 100-foot land buffer, is included in the model. Areas designated as natural swamp waters are Coastal Plain waters have been determined to be in good natural condition. These streams naturally have low dissolved oxygen and low diversity of aquatic insects and fish, so they do not have high bioclassification scores. However, they represent the best data available for identifying good examples of aquatic communities and were considered to be indicators of the same level of integrity as the excellent fish and benthic sites.

  This is a widely accepted method for rating the quality of streams in North Carolina. Streams with high ratings that are consistent over time are areas of unusually intact aquatic communities. Because we do not yet have the ability to cover aquatic communities as we do terrestrial communities, this is one of several measures used to identify examples of aquatic communities in excellent condition. Since many coastal plain streams cannot be ranked according to the bioclassification, the "Natural" designation of swamp waters is valued the same as excellent fish or benthic macroinvertebrate sites.

  Excellent/Natural rated waters represent a portion of the most significant aquatic communities in the state, and are given a value (9). Excellent bioclassification sites and Natural Swamp Waters are rare and considered among the best, but do not represent a portfolio or selection of the best examples. They are based on well-studied sample points that represent a high level of site-specific knowledge of community condition. However, the extent of the high quality community beyond the sample point is not well known. Using the standard DWQ standard ratings, “good” bioclassification sites are not as high quality as the "excellent" sites; therefore they receive a slightly lower ranking (7).

  Bioclassification sites are analogous to EOs of terrestrial communities, with the high bioclassification score analogous to a high EO rank. Since most high quality terrestrial communities are included within SNHAs, and since aquatic communities have not been designated yet, the aquatic communities represented by the excellent bioclassification sites were given a higher rating than free-standing community EOs of high EO rank.

  While good bioclassification waters are significant for water quality in North Carolina, they do not necessarily harbor rare species; therefore, they are given a lower rating than those areas with the rare species present. In

addition, they are not as high quality as the “excellent” sites; therefore, they receive a lower ranking.

- High Quality Waters (HQW)
  High Quality Waters is a supplemental classification developed by the Division of Water Quality intended to protect waters with quality higher than state water quality standards. A waterway can be named HQW by definition or can be designated as HQW. The following are High Quality Waters by definition (http://h2o.enr.state.nc.us/csu/swc.html#HQW, June 2007):

  - Water Supply I or II waters;
  - Shellfishing waters;
  - Outstanding Resource Waters;
  - Waters designated as Primary Nursery Areas or other functional nursery areas by the Marine Fisheries Commission; or
  - Native and Special Native (wild) Trout Waters as designated by the Wildlife Resources Commission.

  There are also waters that can be given supplemental designation as High Quality Waters. These include:

  - Waters for which Division of Water Quality (DWQ) has received a petition for reclassification to either WS-I or WS-II, or
  - Waters rated as Excellent by DWQ.

  Only HQWs with a strictly biologically based definition were included in this model. Water Supply watersheds were excluded, as were shellfishing waters since they are defined as all tributaries that flow into shellfishing areas. The designated stream reach, along with its 100-foot land buffer, is included in the model. While HQWs are significant for water quality in North Carolina, they do not necessarily harbor rare species and they are of lesser quality than Outstanding Resource Waters, therefore, for this assessment they are given a lower ranking (8) than those areas with the rare species present.

- Outstanding Resource Waters (ORW)
  Outstanding Resource Waters is a classification assigned by the Division of Water Quality, and it is intended to protect unique and special waters having excellent water quality and of exceptional state or national ecological or recreational significance. To qualify, waters must be rated as having excellent water quality by the Division of Water Quality and also have an “outstanding resource value,” as defined by DWQ (http://h2o.enr.state.nc.us/csu/swc.html#ORW, June 2007). This resource value must be one of the following:

  - Outstanding fish habitat or fisheries;
  - Unusually high level of water-based recreation;

- Some special designation, such as North Carolina or National Wild/Scenic/Natural/Recreational River, National Wildlife Refuge, etc.;
- Be an important component of a state or national park or forest; or
- Be of special ecological or scientific significance (rare or endangered species habitat, research or educational areas).

As with HQWs, this model only mapped ORWs that had a biological basis (or select); recreation and special designation ORWs were omitted. The designated stream reach, along with its 100-foot land buffer, is included in the model. ORWs represent aquatic communities that are in excellent condition, and often harbor rare species as well. They also represent a portion of the most significant aquatic communities in the state. Not only do they have excellent water quality, but they also contain outstanding resource values, including rare or endangered species habitat. They are rare and considered among the best, but do not represent a portfolio or selection of the best examples. They are well-studied streams that represent a high level of site-specific knowledge of community condition; therefore, they are given a high conservation value (9) ranking. Because they are designated by a process of nomination and public acceptance, the completeness of this data layer is limited.

ORW NOTE: It has recently come to our attention that in the event that an ORW temporarily deteriorates, it can be simultaneously listed on the 303D list. This "temporary" action does not take the water body off of the ORW list. Therefore, you should cross reference these two data sets with DWQ during your evaluation process. We will address this issue in the next iteration of the CPT.

- Oyster sanctuaries

  Oyster sanctuaries are subtidal oyster reefs that have been restored by the Division of Marine Fisheries and other nonprofit partners, primarily in the Pamlico Sound system. In these areas, natural materials have been added to restore the three-dimensional structure of the reefs. The areas are marked and designated for conservation. No harvest is allowed.

  Subtidal oyster reefs in the Pamlico Sound system are severely depleted from historical levels, primarily due to overharvesting. Although the various fishing practices that originally damaged the oyster habitat have been eliminated or greatly reduced, disease and habitat degradation have slowed natural recovery. The restored oyster sanctuaries were strategically selected in areas where they historically occurred, would provide critical refuge for fish and invertebrates, would act as core spawning sanctuaries to release eggs and larvae to adjacent areas, and could improve water quality conditions through their filtering capabilities.

  These areas are given a relatively high (8) rank because their locations are well documented, they are regularly monitored by DMF staff, and they are

relatively rare. They have become colonized with a diversity of organisms, including new oysters, and are providing fish refuge and foraging areas. Populations of subtidal oyster reefs are severely depleted, so these areas represent limited and historically important habitat.

- Hard Bottom Areas
  Hard bottom habitats are exposed areas of rock or consolidated sediments, which are usually colonized by a thin veneer of live or dead biota, generally located in the ocean. Hard bottom, also referred to as live bottom, can be colonized with sponges, coral, algae and other invertebrates, supporting a very diverse community, including subtropical reef fish and a valuable snapper-grouper fishery. Hard bottom is mapped by the Division of Marine Fisheries.

  This habitat is relatively rare and unique in North Carolina and greatly enhances the diversity of fish and invertebrates that can survive in North Carolina, and therefore received a Medium-High Conservation value (7) ranking.

- Shell bottom in open shellfish harvest areas
  Intertidal and subtidal oyster reefs or concentrations of shell mapped by the DMF and located in waters having Division of Environmental Health shellfish harvest classifications of open, conditionally approved open, and conditionally approved closed. These areas represent shell bottom occurring in areas of highest water quality.

  Shell bottom is unique in that it is both a natural habitat and a culturally important fishery. The epifaunal habitat provides three-dimensional fish habitat in estuarine waters. The small crevices provide refuge for small and juvenile fish species, foraging areas for larger fishery species, and support a higher abundance and diversity of organisms compared to unstructured soft bottom. Oyster reefs also provide many ecosystem services, such as filtering pollutants from the water column, stabilizing sediments and reducing shoreline erosion. It is important from an ecological and economic standpoint to maintain shell bottom habitat and the oyster fishery.

  Oyster beds in open harvest areas represent a high quality estuarine habitat, and received an (8) ranking. Much supporting data exist for the mapped oyster beds. They are very vulnerable to water quality degradation from adjacent land use. Oyster beds in areas closed to shellfish harvest also offer valuable fish habitat. However, these waters are listed as impaired by DWQ. The water quality degradation that has been shown to co-occur with increased fecal coliform contamination (elevated loading of nutrients, sediments and, toxins) indicates that these areas are of lower overall condition. Oyster beds in closed areas could be included at a lower ranking or omitted.

Mapping of oyster beds has not yet been completed for Brunswick County and the Pamlico Sound. In Brunswick County, oyster beds are known to be very abundant, but they are currently unmapped and much area is closed to harvest. Oyster sanctuaries described in this report will capture some of the Pamlico Sound oyster beds. Further evaluation of specific oyster beds and completion of mapping in all areas could support an increase in ranking of a subset of the oyster beds.

- Fish Nursery Areas (FNA)
  The Division of Marine Fisheries designated certain estuarine areas as fish nursery areas. Past and present sampling indicates that these areas support a high abundance and diversity of juvenile fish species, particularly for estuarine dependent species that are spawned offshore during winter and migrate into the estuary. These nursery areas generally consist of shallow soft bottom in the upper reaches of tidal wetland creeks. While a few dominant species tend to dominant the composition, over 175 juvenile species have been documented. Areas are designated as primary or secondary nursery areas. Juveniles tend to settle out first in the shallowest and most upstream sites (primary nursery areas), and then migrate downstream to slightly deeper water (secondary nursery areas). There are about 147,000 acres of designated nursery areas in North Carolina.

  These areas are considered by DMF to be the highest quality nursery areas for many of the most common and important fishery species in North Carolina, including shrimp, flounder, blue crab, spot and croaker, as well as a diversity of other species. Maintaining these areas in good condition is critical to the health of the entire estuarine system, therefore they received an (8) ranking.

  The location and description of these areas is well documented, and juvenile fish data has been collected since the 1970s. Analyses have been conducted on the fish data and environmental factors associated with these areas of high productivity. These areas are not particularly unique from each other, but are critical to sustaining NC's productive fisheries.

- Submerged Aquatic Vegetation Beds (SAV)
  Submerged aquatic vegetation habitat is bottom that is recurrently vegetated by living structures of submerged rooted vascular plants, and includes the unvegetated areas between grass patches. This habitat occurs in subtidal and intertidal zones and may be colonized by estuarine or freshwater species. This habitat has been partially mapped by federal and state agencies. There are thought to be approximately 200,000 acres of SAV in North Carolina.

  SAV habitat is well known for its numerous fish and invertebrates. More than 150 species have been documented using this habitat, mostly as a nursery

area for summer spawned estuarine dependent species, such as black sea bass, red drum, spotted sea trout, weakfish and hard clams. Bay scallops, which are currently severely depleted in population, are highly dependent on this habitat for survival. Protection of this habitat would allow a greater diversity of organisms to survive in North Carolina's coastal waters.

SAV maps have been developed through a combination of remote sensing and field monitoring. The mapping of SAV is not yet complete for some areas, and there is not enough data to support prioritization within grassbeds. Once mapping is complete for the entire coast, and the environmental factors that enhance SAV growth are better understood, a subset of SAV habitat could be selected as a higher priority. Currently, SAV habitat is given a (6) ranking in this assessment.

- Strategic Habitat Areas (SHA)
  Strategic Habitat Areas were defined in the Coastal Habitat Protection Plan (CHPP) as "specific locations of individual fish habitats or systems of fish habitats that have been identified to provide exceptional habitat functions or that are particularly at risk due to imminent threats, vulnerability or rarity" [Coastal Habitat Protection Plan, p. 447, 2004]. These areas will represent strategically located high quality areas that support a diversity of organisms, are extremely productive or are of critical importance to the ecosystem. They will be ranked based on their condition and vulnerability to threats.

  While the process used to identify these areas has been developed, the analysis has only been completed for one of the 4 coastal regions.
  As of July 2009, the draft designation of Region 1 SHAs has been created and incorporated into the Biodiversity/Wildlife Habitat Assessment. As part of the SHA analysis, the condition or "alteration state" of each area was rated and this information, combined with the occurrence of habitat targets determined their selection. The selected SHAs in the least altered condition were classified as "SHAs to protect" (the highest quality) and ranked as 10. Those slightly more altered were classified as "SHAs to enhance/restore," and ranked as 9. SHA selections only included submerged or wetland habitat types and were clipped to only extend 500 m from the water edge. Almost all of the SHAs in this area were Anadromous Fish Spawning Areas (AFSAs) or connected to AFSAs and had fish data to support their relatively high function. Even if potentially altered, these AFSAs would be critical to protect.
  Download the final report for the Region 1 SHAs as well as the supporting document that provided the methodology at the following web site:
  http://www.ncfisheries.net/habitat/chpp28.html

  While not all SHAs regions are included at this time in the assessment, we plan to include additional regions as they are completed. Designation is expected to be complete within the next 2-3 years. Portions of the areas described below will most likely be selected as SHAs. Until SHAs have been

designated, these habitat areas should be a priority, but at a somewhat lower ranking to allow refinement of condition through the SHA process. Refer to the DMF report - Process for identification of Strategic Habitat Areas in coastal North Carolina (Deaton et al. 2007)

- Stream Buffers
  A riparian buffer is the area of land adjacent to ephemeral, intermittent and perennial streams, rivers and other bodies of water that serves as a transition zone between aquatic and terrestrial environments and directly affects or is affected by that body of water. Riparian ecosystems perform many functions that are essential to maintaining water quality, aquatic species survival and biological productivity. Riparian buffers represent the most effective and efficient way we can address water quality and habitat through spatial planning, and should be part of a larger holistic strategy for conservation of aquatic ecosystems. The overall implementation strategy should take into account increased impervious surface and stormwater impacts, and human practices that can bypass or circumvent intact riparian buffers.

  Although effective buffer size depends on specific site conditions, such as slope and soil type, we did not have enough data to determine the effective buffer size for streams across the state. Therefore, this assessment used several uniform width buffers for application across the North Carolina landscape; these are measured from the toe of the slope on one side of a water body. Buffers were applied to streams from the N.C. DWQ's Assessment Unit Hydrology data layer, and will be applied to the National Hydrography Dataset as it becomes available.

  According to literature reviews and “the majority of scientific findings, land use practitioners should plan for buffer strips that are a minimum of 25 meters (82 feet) in width to provide nutrient and pollutant removal; a minimum of 30 meters (98 feet) to provide temperature and microclimate regulation and sediment removal; a minimum of 50 meters (164 feet) to provide detrital input and bank stabilization; and more than 100 meters (328 feet) to provide for wildlife habitat functions. To provide water quality and wildlife protection, buffers of at least 100 meters are recommended” (ELI, 2003). These recommended width measurements are from the top of the bank or level of bankfull discharge of one side of a water body.

  As documented by the N.C. Wildlife Resources Commission (August 2002 and references therein):

  > "Wide, contiguous riparian buffers have greater and more flexible potential than other options to maintain biological integrity and could ameliorate many ecological issues related to land use and environmental quality. As expansion of developed areas continues into the watershed, wildlife habitat can change,

> become fragmented and even disappear. Riparian buffers provide travel corridors and habitat areas for wildlife displaced by development. In addition, riparian buffers serve to protect water quality by stabilizing stream banks, filtering capacity of stormwater runoff, and provide habitat for aquatic and fisheries resources."

By virtue of their high productivity, diversity, continuity and critical contributions to both aquatic and upland ecosystems, intact riparian ecosystems provide vital resources to North Carolina's fish and wildlife. Because these are distinctly valuable habitats, we have included riparian buffers on all streams throughout North Carolina. In our model, both the significance of the waters being buffered and their ratings are used in determining the width of riparian buffers. Buffers of 100 feet or 200 feet were assigned to all water related criteria. For Outstanding Resource Waters, High Quality Waters, native trout waters, anadromous fish waters, Excellent and Good fish and benthic bioclassification sites and natural swamp waters, the 100-foot buffer is incorporated into the data layer along with the actual stream segments.

Priority watersheds have been designated by several resource groups, including NHP, WRC and TNC. NHP priority watersheds were designated based on all 14-digit HUCs that touch an ASNHA. WRC priority watersheds were designated based on areas identified for habitat conservation and restoration. Criteria include areas with high species diversity, rare species and endemic species; specific areas that are critical to the survival of N.C. Wildlife Action Plan priority species (e.g., particular streams or spawning sites); and areas recognized by previous national and/or regional prioritization efforts. TNC priority watersheds were designated based on occurrences of target species (i.e., imperiled, endemic, declining and wide-ranging species) and ecological systems that experts identified as conservation priorities. The priority areas were represented in three ways: 1) for creeks and small rivers, the entire watershed area was highlighted; 2) for medium and large rivers, stream lines were buffered by 1 kilometer; and 3) for spring complexes, important caves, and natural lakes with or without upstream or downstream tributary connections, polygons were delineated. Streams within these watersheds are given 100-foot or 200-foot buffers, with the larger buffers on streams in watersheds contributing to federally listed species habitat (WRC 2002). Protection of buffers on tributary streams in these watersheds is essential to protecting significant waters downstream.

After stream buffers were defined based on distance from the stream, cells with high (>20 percent) impervious surface cover and row crop agriculture were removed. These degraded areas are important to water quality in the adjacent streams, but are in need of restoration rather than conservation of current conditions. They will be incorporated into the restoration map instead.

Suggested Buffer Widths, Categories and Assigned Rankings

Stream Buffer Width	Category	Assigned Ranking for Conservation Value
200 ft.	Watersheds with federally listed species	Medium – High (7)
100 ft.	NHP/WRC/TNC priority watersheds	Low (3)
100 ft.	All streams without additional significance	Limited (1)

All stream buffers are limited in level of knowledge and spatial precision, since they are calculated by a fixed distance from the stream rather than from a more direct measure of their function, and carry no consideration of the specific condition of each. However, all stream buffers are important to water quality and aquatic ecosystems, and thus have an important functional value to the local ecosystem. For these reasons, all riparian buffers are included in the plan, and their ratings vary with the distinctive value of the streams they buffer.

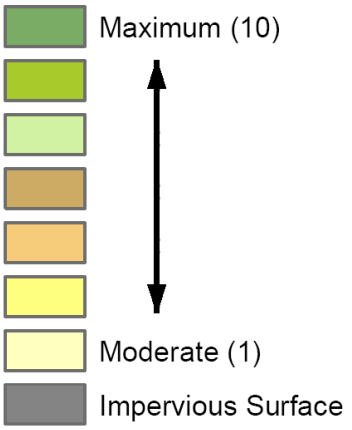
Buffers on most streams, other than those otherwise identified as having special values, are among the most common of ecologically significant lands, and the least unique. They are low in distinctiveness and are interchangeable on the same stream. For this reason, they are given the lowest ranking on the scale.

Stream buffers in watersheds containing federally listed species are rated based on their critical importance for rare species and high quality aquatic communities, in addition to their contribution to general water quality. Most of the water in the aquatic area of interest comes from the upstream tributaries, and is filtered through the stream buffers on them. While slightly less important than the immediately adjacent buffers, which also provide shading, bank stabilization, organic matter impact and other functions, they are given a Medium-High Conservation value (7) rank for their strong contribution.

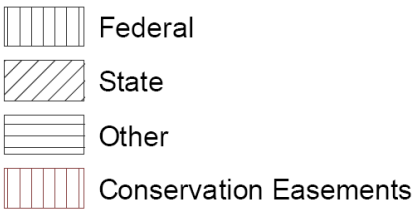
NHP/WRC/TNC priority watersheds represent other stream systems selected as representing valuable aquatic resources, but without a single focal stream. Streams in these watersheds provide habitat not only for rare species, but also for wider ranging species that are in decline. Stream buffers in these priority watersheds are rated based on the importance of the habitat they provide for aquatic resources, but are given lower range ratings because they are somewhat diffuse and include a large number of streams within a watershed.

Biodiversity/Wildlife Habitat Assessment Legend

Relative Conservation Value



Conservation Land



Key to Identify Tool results for the Biodiversity/Wildlife Habitat Assessment		
Category Name	**Value**	**Individual Input Layers**
NHP	10	Significant Natural Heritage Areas – National or State Significance *(N.C. Natural Heritage Program)*
NHP	8	Significant Natural Heritage Areas -Regional Significance
NHP	6	Significant Natural Heritage Areas - Local Significance
NHP	5	Element Occurrences – High ranking
NHP	4	Element Occurrences – High ranking - Other
Wetlands	7	Coastal Region Evaluation of Wetland Systems /CREWS – Exceptional ranking *(N.C. Division of Coastal Management)*
Wetlands	6	Coastal Region Evaluation of Wetland Systems /CREWS – Substantial ranking *(N.C. Division of Coastal Management)*
Wetlands	5	National Wetlands Inventory *(U.S. Fish & Wildlife Service)*
Wetlands	2	Coastal Region Evaluation of Wetland Systems /CREWS – Beneficial ranking *(N.C. Division of Coastal Management)*
Guilds	1-10	Landscape Habitat Indicator Guilds *(N.C. Natural Heritage Program)*
DWQ	10	Outstanding Resource Waters *(N.C. Division of Water Quality)*
DWQ	9	BioClass Excellent
DWQ	8	High Quality Waters
DWQ	7	BioClass Good
DWQ	1	All other streams
FishHabitat	9	Native Brook Trout *(N.C. Wildlife Resources Commission)*
FishHabitat	8	Anadromous Fish Spawning Areas *(N.C. Division of Marine Fisheries)*
FishNursery	8	Fish Nursery Areas *(N.C. Division of Marine Fisheries)*
Watersheds	7	Stream buffer tributaries to Threatened & Endangered Species *(N.C. Wildlife Resources Commission)*
Watersheds	3	Priority Watersheds *(N.C. Natural Heritage Program, Wildlife Resources Commission, The Nature Conservancy)*
Marine	8	Oyster Sanctuaries *(N.C. Division of Marine Fisheries)*
Marine	6	Submerged Aquatic Vegetation
Hardbottom	8	Open ShellFish /Hardbottom (N.C. Division of Marine Fisheries)
Hardbottom	7	Hard Bottom
Hardbottom	5	Closed Shellfish /Hardbottom
IBA	6	Important Bird Area *(Audubon)*
Impervious	99	Impervious Surface above 20% *(U.S. Environmental Protection Agency)*